

Perioperative problems in patients with brainstem tumors and their influence on patient outcome

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Abstract

Background and Aims: Patients with brainstem tumors have many associated systemic abnormalities and are prone to develop perioperative complications. We studied the problems associated with brainstem tumors and their influence on the postoperative neurological outcome.

Material and Methods: Retrospective review of records of patients who underwent surgery for brainstem tumors over a period of 8 years was done. Preoperative variables, perioperative complications and neurological outcome as assessed by Glasgow Outcome Scale at the time of hospital discharge were noted. Association between perioperative factors and the unfavorable neurological outcome was evaluated.

Results: Data of 70 patients were retrieved, 7 patients were excluded from the study because of incomplete data and data analysis was carried out for 63 patients. We found that lower cranial nerve palsies (32%) and hydrocephalus (43%) were common preoperatively. Various intraoperative problems encountered were hemodynamic instability (56%), major blood loss requiring blood transfusion (40%) and venous air embolism (11%), and postoperative problems were meningitis (51%), hypokalemia (38%), chest infection (21%), seizure (11%), deterioration of Glasgow Coma Scale (GCS, 11%), hyponatremia (8%), hydrocephalus (6%), respiratory distress (3%) and operative site hematoma (3%). Fifty-six (89%) patients had favorable outcome at hospital discharge whereas, 7 (11%) had an unfavorable outcome. There was no association between pre- and intra-operative factors and the neurological outcome. Deterioration of GCS, chest infection, and the need for reintubation and tracheostomy were associated with unfavorable neurological outcome.

Conclusion: Patients of brainstem tumors are at increased risk of perioperative complications. Some of the postoperative complications were associated with unfavorable neurological outcome.

Key words: Brainstem tumor; intraoperative complications, neurological outcome, postoperative complications

Introduction

Brainstem tumor patients generally present with many associated systemic abnormalities and are prone to develop complications in the perioperative period. Various causes of

these complications are contrast agents, electrolyte disturbances, loss of airway reflexes, pulmonary aspiration, hydrocephalus, chest infection, and the need for prolonged intravenous fluids, diuretics, and ventilator support.^[1-5] Associated systemic abnormalities and perioperative complications can have significant adverse effects on patient outcome. The scarcity

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of data about the systemic abnormalities in these patients prompted us to conduct a retrospective review to enumerate the perioperative problems in these patients and the factors associated with unfavorable neurological outcome.

Material and Methods

This is a retrospective review of the patients who underwent surgery for brainstem tumors at our institute between January 2002 and December 2009. After approval of the ethics committee, data were collected by reviewing the patients' medical records including; anesthetic records and perioperative notes. Following preoperative data were collected: age, sex, weight, American Society of Anesthesiologists physical status, associated systemic illness, cough and gag reflexes, type of tumor, and neurological deficits. The intraoperative data of blood transfusion and complications such as hemodynamic instability (hypotension requiring vasopressor therapy), venous air embolism (VAE, sudden and sustained fall in EtCO₂ by 5 mmHg or more), and hypothermia (core temperature <36°C) were recorded. Postoperative data regarding mechanical ventilation, lower cranial nerve (LCN) function deterioration, Glasgow Coma Scale (GCS) deterioration, occurrence of respiratory distress, residual tumor, reintubation, and tracheostomy, occurrence of various complications (meningitis, electrolyte disturbances, chest infection, postoperative hydrocephalus, seizure, postoperative hematoma), duration of Intensive Care Unit (ICU) and hospital stay and Glasgow Outcome Score (GOS) at the time of hospital discharge were recorded.^[6]

On the basis of GOS at the time of hospital discharge, patients were divided into two groups as favorable GOS

group (GOS score: 4 or 5) and unfavorable GOS group (GOS score: 1-3).^[6]

Statistical analysis

Statistical analysis was performed using software Stata 9.0 (College Station, Texas, USA). Data are expressed as mean \pm standard deviation or number (%). *t*-test and Fisher's exact test were carried out for continuous and categorical variables respectively, to compare different variables between the two groups. *P* <0.05 was considered as significant.

Results

A total of 70 patients were operated during this period. Seven patients were excluded from the study because of incomplete data, and data analysis was done for 63 patients. The demographic and preoperative characteristics of the patients are given in Table 1. Twenty (31.7%) patients presented with the involvement of LCNs with impaired gag reflex. Twenty-seven (42.9%) patients had hydrocephalus.

Majority of patients were operated in prone (36 patients, 57%) or sitting position (17 patients, 27%) but, some patients were operated in supine position (8 patients, 13%) and lateral position (2 patients, 3%) as well. Balanced anesthesia technique consisting of O₂: N₂O, isoflurane, fentanyl, and vecuronium/rocuronium, was used in all cases. Along with routine monitoring (heart rate, electrocardiography, pulse oximetry, temperature and end-tidal CO₂), monitoring of invasive blood pressure and central venous pressure was also carried out in all patients. The intraoperative complications are given in Table 2. Seven (11.1%) patients had VAE

Table 1: Preoperative factors and outcome

Parameters	All patients (n = 63)	Favorable GOS group (n = 56)	Unfavorable GOS group (n = 7)	P value
Age (years)	19.5 \pm 14.3	19.9 \pm 14.7	15.9 \pm 11.1	0.480
Sex				
Male	42 (66.7)	38 (67.9)	4 (57.1)	0.67
Female	21 (33.3)	18 (32.1)	3 (42.8)	
Weight	39.8 \pm 20	40.8 \pm 20.5	31.3 \pm 14.1	0.23
ASA grade				
1	59 (93.6)	52 (92.9)	7 (100)	0.76
2	2 (3.2)	2 (3.2)	0	
3	2 (3.2)	2 (3.2)	0	
Location of tumor				
Midbrain	11 (17)	11 (19.6)	0	0.31
Pons	13 (21)	10 (17.9)	3 (42.9)	
Medulla	33 (52)	30 (53.6)	3 (42.9)	
Diffuse	6 (10)	5 (8.9)	1 (14.3)	
Lower cranial nerve palsy	20 (31.7)	16 (29)	4 (57)	0.195
Hydrocephalus	27 (42.9)	24 (43)	3 (43)	1.00

Data are shown as n (%) or mean \pm standard deviation. GOS = Glasgow Outcome Scale, ASA = American Society of Anesthesiologists

during surgery and they were all operated in sitting position. VAE did not result in any clinically significant alteration in hemodynamic parameters. Hemodynamic instability requiring vasopressor therapy occurred in 35 (55.5%) patients.

The postoperative complications are given in Table 3. Fourteen patients were extubated immediately after surgery, and 49 were electively ventilated. Of the 20 patients who presented with the involvement of LCNs, 7 (35%) patients had further deterioration in their LCNs in the postoperative period, as shown by impaired cough reflex. All of these 7 patients had brainstem handling manifesting with hemodynamic disturbances during the intraoperative period. All the 13 (20.6%) patients who developed chest infection in the postoperative period, had preexisting LCN palsies. Ten (15.8%) patients who were extubated after surgery required reintubation in the ICU, 2 due to acute onset respiratory distress, 7 due to deterioration in the sensorium and 1 due to generalized seizures. Three of them eventually needed tracheostomy due to the requirement of prolonged ventilation. In addition, another 3 patients required tracheostomy due to a superimposed chest infection, weaning failure, and prolonged ventilation. Two patients (3.2%) developed operative site hematoma in the postoperative period. One underwent surgical evacuation whereas, the other was managed conservatively. In our study, meningitis occurred in 32 (50.8%) patients and of them, 27 (84.4%) had associated

cerebrospinal fluid (CSF) leak. Four (6.3%) patients had generalized seizure in the postoperative period, and in 3 of them hyponatremia ($\text{Na} < 120$) was the reason.

Mean duration of ICU stay was 4.3 days (range: 2-16 days) and mean duration of hospital stay was 14.1 days (range: 4-60 days). Of 63 patients, 56 (88.9%) patients had favorable outcome at hospital discharge whereas, 7 (11.1%) patients had an unfavorable outcome. Four (6.3%) patients died in the postoperative period, 2 patients (3.2%) remained severely disabled and 1 patient (1.5%) was discharged in a vegetative state.

Factors which were found to be associated with unfavorable GOS were deterioration of GCS, chest infection, need for reintubation and tracheostomy [Table 3].

Discussion

In this study of patients with brainstem tumors, we examined the incidence of various perioperative factors and their influence on the neurological outcome at the time of hospital discharge. We observed a high incidence of preoperative hydrocephalus (43%) and preexisting LCN palsies in (32%) our study population. Similar incidence of hydrocephalus and LCN palsies were also observed in earlier studies.^[1,4,7-12]

Table 2: Intraoperative complications and outcome

Complications	All patients (n = 63)	Favorable GOS group (n =56)	Unfavorable GOS group (n =7)	P value
Haemodynamic instability	35 (55.5)	31 (55.3)	4 (57.1)	0.929
Blood transfusion	25 (39.7)	21 (37.5)	4 (57.1)	0.421
Venous air embolism	7 (11.1)	6 (10.7)	1 (14.3)	0.581
Hypothermia	3 (4.8)	3 (5.4)	0	1

Data are shown as n (%) of patients. GOS = Glasgow Outcome Scale

Table 3: Postoperative complications and outcome

Complications	Total patients (n = 63)	Favorable GOS group (n =56)	Unfavorable GOS group (n =7)	P value
Postoperative ventilation	49 (77.8)	42 (75)	7 (100)	0.333
Meningitis	32 (50.7)	28 (50)	4 (57.1)	1
Hypokalemia	24 (38)	20 (35.8)	4 (57.1)	0.412
Residual tumor	17 (27)	14 (25)	3 (42.9)	0.375
Chest infection	13 (20.6)	9 (16)	4 (57.1)	0.028
Reintubation	10 (15.9)	6 (10.7)	4 (57.1)	0.01
Lower cranial nerve function deterioration	7 (11.1)	5 (8.9)	2 (28.6)	0.170
GCS deterioration	7 (11.1)	3 (5.4)	4 (57.1)	0.002
Tracheostomy	6 (9.5)	3 (5.4)	3 (42.9)	0.015
Hyponatremia	5 (8)	3 (5.6)	2 (28.6)	0.091
Postoperative hydrocephalus	4 (6.3)	2 (3.6)	2 (28.6)	0.058
Seizure	4 (6.3)	2 (3.6)	2 (28.6)	0.05
Respiratory distress	2 (3.2)	0 (0.00)	2 (28.6)	0.058
Postoperative hematoma	2 (3.2)	1 (1.8)	1 (14.3)	0.211

Data are shown as n (%) of patients. GOS = Glasgow Outcome Scale, GCS = Glasgow Coma Scale

Various intraoperative problems encountered in our patients were hemodynamic instability requiring vasopressor therapy, occurrence of VAE, major blood loss requiring blood transfusion. We did not find any significant association between preoperative and intraoperative factors on neurological outcome.

We observed a significant association between postoperative complications and unfavorable neurological outcome. Various postoperative factors found to be associated with unfavorable outcome were GCS deterioration, chest infection, and the need for reintubation and tracheostomy.

Infratentorial surgeries carries a higher rate of CSF leak, which may contribute to a higher rate of postoperative meningitis.^[13-15] In our study, meningitis occurred in 32 (51%) patients and 27 (84%) of these patients had CSF leak. Several factors which can predispose to CSF leak include tumor size, a dural invasion of the tumor, hydrocephalus, blood in CSF, and brain edema.^[13-15]

Brainstem tumors patients are prone to develop a number of complications in the postoperative period leading to prolonged mechanical ventilation. Factors responsible for increased risk of respiratory complications are damage to the respiratory center, LCN palsies, altered sensorium, pulmonary aspiration, need for reintubation and prolonged ventilation. Chevron *et al.*, in a prospective case-control study, found that a low consciousness level correlated with the need for reintubation.^[16] The incidence of reintubation in neurosurgical patients, in general has been described as 0.56-8.2% and has been attributed to both anesthetic and surgical factors.^[17,18] However, none of these studies were conducted in patients of brainstem tumor. Brainstem tumor patients may be more prone to reintubation because of the damage to the respiratory center, LCN palsies, and altered sensorium. This was the reason of high incidence of reintubation in our study (16%), as compared with the low incidence reported in general neurosurgical population.

Thirteen (21%) patients developed chest infection in the postoperative period. All of these patients had impaired LCNs and gag reflex in the preoperative period. The impaired gag reflex is known to cause chest infection due to impaired swallowing, pooling of saliva in the oral cavity and silent aspiration. High incidence of postoperative elective ventilation, decreased sensorium, and reintubation are the other possible reasons for the postoperative chest infections.^[19] Jallo *et al.* in a retrospective analysis of 41 children and adolescents with brainstem medullary tumors, reported loss of LCN in 46% of them, 11% of patients had pneumonia in the postoperative period and all of them required tracheostomy.^[4] Sogame *et al.* in their study in elective intracranial surgery reported that the

predicting factors for postoperative pulmonary complications are prolonged mechanical ventilation (≥ 48 h), time spent in ICU (> 3 days), decreased in level of consciousness, duration of surgery (≥ 300 min), and preexisting chronic lung diseases.^[19]

Generalized seizures following neurosurgery may lead to deterioration of patient's condition and the need for intubation and mechanical ventilation. Suri *et al.* in a retrospective study of posterior fossa surgeries (for diverse types of pathologies) in 511 patients reported 5.9% incidence of seizures.^[20] Our incidence of 6% is in agreement with their observation. Whereas, in their series, most common cause of seizures was tension pneumocephalus, it was hyponatremia in our series. The main reason for different etiology of seizures in their series versus ours could be the more frequent employment of sitting position in their study (48.9% vs. 27%).

The retrospective nature of the study and the small sample size are the limitations of our study. A larger sample size with a multifactorial regression analysis would have shown independent predictors of the unfavorable neurological outcome.

Conclusion

The patients of brainstem tumors are at increased risks of perioperative complications. We found that the occurrence of GCS deterioration, chest infection, reintubation, and tracheostomy in the postoperative period is associated with unfavorable outcome. Further, larger prospective studies are required for determination of independent predictors of unfavorable outcome.

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Conflicts of interest

There are no conflicts of interest.

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Conference Calendar April 2016

Name of conference	Dates	Venue	Name of organising Secretary with contact details
European Society of Regional Anaesthesia 35 th Annual Congress 2016 (ESRA 2016)	September 7 th -10 th , 2016	6229 GV MECC Maastricht. The Netherlands	http://www.esra2016.com/ CONGRESS VENUE MECC Maastricht Address: Forum 100, 6229 GV Maastricht Telephone: +31 (0)43 38 38 383 Email: info@mecc.nl
Annual East Zone Conference of ISA ISACON EAST – 2016	September 9 th -11 th , 2016	Puri, Odisha	Dr. Debaprasad Mohanty Mobile No.: +91-9437021313 drdev07@yahoo.com
ISACON UP – 2016 Annual State Conference of ISA UP State Chapter	September 9 th -11 th , 2016	Corbett National Park, Nainital	Org Secretary: Dr. R. K. Bhaskar Mobile No.: +91- 9837027227 Email: rkbhasker@gmail.com
ISACON MP 2016 30 th Annual State Conference of ISA MP State Chapter	September 10 th , 2016	Hotel Jabali Palace, Jabalpur	Org Secretary: Dr. Ashish Sethi Mobile No.: +91-9826168747 Email: ashsethi64@yahoo.com Website: http://www.isampchapter.com
Society For Airway Management 19 th Annual Meeting 2016 (SAM 2016)	September 15 th -18 th 2016	Atlanta, Georgia, USA	http://samhq.com/2014-sam-meeting-in-seattle-washington/ The Society for Airway Management is a 501(c)(3) organization 5753 Tanager Street Schererville, IN 46375 PH: (773) 834-3171 FAX: (773) 834-3166 Administrator: amprince@peds.bsd.uchicago.edu Webmaster: webpagesam@gmail.com
7 th National Airway Conference NAC 2016	September 16 th -19 th 2016	Vadodara	Dr. Amit Shah Organizing Chairman Dr. Apeksh Patwa Organizing Secretary Contact: Dr. Dinesh Patel Telephone : 9879925025 Email Id: nac2016vadodara@gmail.com Website: http://www.nac2016.in
ISACON AP – 2016 25 th Annual State Conference of ISA AP State Chapter	September 16 th -18 th 2016	Tanish Function Hall, Kurnool, AP	Org Secretary: Dr. G. Shantiraju Mobile No.: +91 7702228107 9494491910 Email: gunnasraj@gmail.com Website: http://www.isaaccon2016.in/